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Patent
Attorney Docket No. 024444-983

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Katarina Dahl et al.
Application No.: 09/987,941
Filing Date: November 16, 2001
Title: METHOD OF MILLING ENGINE BLOCKS

Group Art Unit: 3722
Examiner: Erica E. Cadugan
Confirmation No.: 7925

SUBMISSION OF CERTIFIED COPY OF PRIORITY DOCUMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The benefit of the filing date of the following priority foreign application(s) in the following foreign country is hereby requested, and the right of priority provided in 35 U.S.C. § 119 is hereby claimed.

Country: Sweden

Patent Application No(s).: 0004274-7

Filed: November 22, 2000

In support of this claim, enclosed is a certified copy(ies) of said foreign application(s). Said prior foreign application(s) is referred to in the oath or declaration and/or the Application Data Sheet. Acknowledgment of receipt of the certified copy(ies) is requested.

Respectfully submitted,

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Date: August 10, 2004

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PRV

PATENT- OCH REGISTRERINGSVERKET
Patentavdelningen

Intyg
Certificate

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This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

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Applicant (s)

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Method of milling engine blocks

The present invention relates to high speed milling of engine blocks comprising aluminium and cast iron. By using silicon nitride cutting tools an unexpected increase in tool life and in productivity has been obtained.

Modern engine blocks for passenger cars are often made of aluminium with cast iron liners. For the machining of these coated cemented carbides and Polycrystalline Diamond (PCD) inserts are generally used. Coated carbides can not be used at cutting speeds above 600 m/min and higher due to too high thermal load. PCD inserts function well but are not competitive due to high cost. Wet milling is used due to surface finish and chip evacuation. Emulsions used in machining are environmental and health problems and lead to a higher cost. Cutting data are; Cutting speed =150-300 m/min and feed-rate/tooth around 0.15-0.30 mm/tooth. Depth of cut is between 0.2 and 1.5 mm.

In general engine blocks are produced in transfer lines and the time pressure is high. Often this operation is a bottleneck in the production. Milling cutters with close pitch are used which leads to change of about 30-40 inserts when they are worn out. One typical wear mechanism is built up edge which leads to a bad surface finish and failure of the cutting edge which leads to rapid wear. The main reason for tool change is surface finish and demands are high which leads to frequent tool changes.

Silicon nitride is a cutting tool material for machining of cast iron due to its good wear resistance and good high temperature properties. The properties of silicon nitride are greatly dependent on the density, and it has been found necessary to add sintering aids to silicon nitride in order to fully densify the body. Typically the sintering aids used are Al_2O_3, BeO, MgO, TiO_2, ZrO_2, HfO_2 and the oxides of the Group III elements of the periodic table scandium, yttrium, lanthanum, cerium, etc. The amount of sintering aid added is of the order of a few wt-%. The sintering aids form during sintering a glass phase, which facilitates the densification. Silicon nitride cutting inserts thus consist of beta silicon nitride in an intergranular glass phase.

It is an extremely high demand to develop tool solutions with a long tool life and less frequent tool changes. Dry machining of

these type of applications is a strong demand in order to reduce costs, health hazards and environmental impacts.

It has now surprisingly been found that dry machining using Silicon nitride inserts at a cutting speed above 1000 m/min a longer tool life and increased productivity can be achieved. The problem with built up edge and wear disappeared surprisingly with these cutting data using silicon nitride inserts. The problems with built up edge remained with silicon nitride inserts in lower cutting speeds and the wear was also higher.

The present invention relates to machining of composite materials (aluminium in combination with cast iron) using silicon nitride inserts.

Cutting data:
Cutting speed = 1000-3000, preferably 1100-2500m/min
Cutting feed/tooth = 0.05-0.5, preferably 0.15-0.30 mm
Cutting depth = 0.2-2 mm, preferably 0.3-1 mm
Chip thickness = 0.09-0.17 mm

Example

Face milling of engine block was performed under the following conditions.

Operation: Face milling, finishing
Work piece: Engine block
Material: Aluminium 8% Si and pearlitic grey cast iron
Cutting speed: See table
Feed rate/tooth: 0.26 mm
Depth of cut: 0.5 mm
Insert style: 28 pcs SBEX1203ZZ-11 and 4 pcs SBEN1203ZZ
Grade 1: Coromant grade 6090.
Grade 2: WC-6% Co cemented carbide with 4 µm TiN+TiC-coating
Milling cutter: Auto FS 260.42 of diameter 250 mm.
Tool life/insert is shown in the table
Tool life criterion: unacceptable surface finish including component frittering.

Result

Tool life/insert	Grade 1 invention	Grade 2 reference
Cutting speed		
444 m/min	10 pcs	22
1178 m/min	60 pcs	not possible
2356 m/min	70 pcs	not possible

Conclusions

With silicon nitride inserts a higher productivity and a longer tool life are achieved, which leads to less problems with bottlenecks in the production and less frequent changes of tools. Another advantage is the need to turn off coolant, which has environmental as well as cost advantages.

Claims

1. Method of milling a material comprising aluminium and cast iron c h a r a c t e r i s e d in using a silicon nitride based cutting tool insert at a cutting speed of 1000-3000 m/min, a feed of 0.05-0.5 mm and a cutting depth of 0.2-2 mm.

2. Method according to claim 1 c h a r a c t e r i s e d in a chip thickness of 0.09-0.17 mm.

Abstract

The present invention relates to a method of milling a material comprising aluminium and cast iron. By using a silicon nitride based cutting tool insert at a cutting speed of more than 1000 m/min an unexpected increase in tool life has been obtained.